# THE MAC Flyer

*May 1986*

The Chief of Staff Special Achievement Award . . . Page 16

# THE MAC Flyer

For Greater Safety in MAC Air Operations

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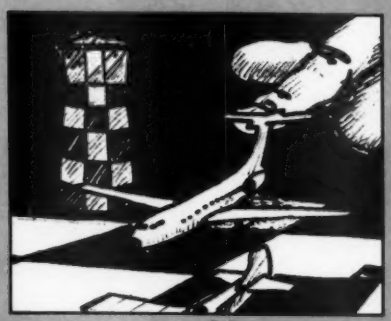

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# An Unanswered Question

## "Did I help kill my best friend?"

by MSgt. Patrick P. Pendergest, Sr.
USAFETAC, Scott AFB, IL

Beth and I paused in our efforts to get one final load of household goods on the truck so we could watch the beautiful sunset on the Pacific Ocean. It had been a tiring day loading the truck, so the sunset, a kaleidoscope of brilliant reds, pinks, soft violets, and oranges, was a welcome break. The ocean provided a mirror image, adding to the dramatic effect of the scene. But the tranquil setting wasn't as peaceful as it should have been. My thoughts wandered back to when I first met John . . . .

I was sitting on my bunk when someone knocked on the door. I responded, "Come on in, the door's open."

Another new recruit said, "Hi, my name's John Jensen. They tell me we're going to be roommates."

"Well, my name's Pat Garmers. Welcome aboard. I have my things on the bed by the window. You don't mind taking the one by the wall, do you? Where do you hail from?"

"I'm from Missouri, Pat, the 'Show Me' state, but you don't have to show me everything. I'll take your word for it, and no, I don't mind the bed by the wall."

From that day on, John and I were almost inseparable. We seemed to have most everything in common and where we lacked common ground we simply paved the way together. We finished first and second in basic preflight training school and were lucky enough to get assigned together for pilot training. I told John that this time I would finish higher than him. I didn't, although I was right behind him in the final grades. We were both selected for instructor pilot training and were able to go to the same class. So off to Texas we went. Instructor pilot school was the scene of some of our best flying and partying. We had an excellent six months there before going our separate ways, but we stayed in contact thanks to Ma Bell and the US Postal Service.

Several years later John was my best man when I married Wendy. By the time we were promoted to captain I was godfather to his son, Patrick. We spent some great times camping with our families in the wide open spaces of Texas. He would bring his family down from the northeast and I would bring mine up from the southeast. The Big Bend area is beautiful in the spring and autumn. (It was too hot in the middle of summer for our liking.)

My thoughts jumped to the time John's wife, Beth, arranged a surprise party for him the day before his birthday. All I had to do was keep him out until after sundown. It was no easy assignment, but with a little help from my friends we kept him out long enough. The look on John's face when he walked through the door was captured on film forever.

The next year I was reassigned to his squadron. That year we both helped our squadron defeat the favored ABG team in the bowling league. It was the first time our squadron had ever won the base title. We threw a grand outdoor party for our team's families so they could share in our celebration. It was a Texas-style cookout complete with 20 pounds of sausage, 50 pounds of brisket, potato salad, beans—the whole nine yards. The party was thoroughly enjoyed by all and we decided to do it again the next year.

John showed just how strong our friendship was last year when he flew in from the coast to be with me after my wife died in a car accident. I don't think I could have made it without his support and understanding. He gave me the strength to continue on with my life.

I remember flying into west Texas. The weather was getting really nasty, but the skies were still filled with aircraft attempting to either evade the weather or to land at El Paso. John was flying in for the same conference and I figured he would probably be on the ground waiting for me.

**Honorable Mention 1985 Flight Safety Writing Contest**

The weather picture was looking a little worse than the afternoon's weather briefing indicated, but the weatherman had warned us of this potential when he briefed about the developing cold front. In the late afternoon sun, thunderstorms were beginning to develop to the west of El Paso. I was getting pretty close to destination so I was not overly worried, just very alert.

The last few minutes of the flight were extremely tense. As I prepared for final approach, I was in IMC and encountered moderate turbulence. As I continued my descent, the air became more turbulent and a driving rain began. I hoped it was just a rainshower, but it turned out to be a rather large thunderstorm! The low level wind shear must have been around 50 knots at 1,000 feet. I was just able to get control of the aircraft in time. Luckily for me I didn't take a lightning strike on the way down. That would have been too much. Once on the ground I thought about what a close call it was. It was something I had not been prepared for. Right then, I should have called the weather station and told them about the wind shear problem, but I was still shaking. Shortly after I regained my composure, I began looking ahead to the evening John and I would spend together.

Three minutes later the crew on the next plane wasn't as lucky. The plane crashed in the field just off the approach end. The ball of flames could be seen for several miles; the noise was like no other I had ever heard. There were no survivors.

It wasn't until later that night I found out John was the pilot of the plane that crashed. My heart sank as I remembered the Pilot Report (PIREP) that I hadn't taken time to pass on.

The next morning I left El Paso and flew to the west coast to be with John's family. I remembered what John had done for me and tried to do the same for his wife and son. Young Patrick would now be the man of the family—a thought that didn't make me feel any better.

The headlines read, "Local Hero Dies in Freak Crash." The article told about John's crash into the field just a few hundred feet short of the El Paso runway. It stated that a thunderstorm was the cause of the accident. The article then went on to tell how John had saved several lives last winter when he landed his ski-equipped, light plane, in the mountains to rescue some snow-bound hunters. At the time, John was quoted as saying, "I don't consider myself a hero, I was just doing what I felt was necessary."

Beth decided to move back to the midwest to be closer to her family. She felt that a change would help ease the pain that she and Patrick felt. I helped her make the arrangements for the funeral. She wanted to move herself; I think she just wanted to keep busy to help her forget the reality of the situation. At least this past week seemed to go fairly well for her.

As I stand here peering at the remnants of the sun, I still can't shake the feeling that John could possibly be alive today had he received a last minute update from the weather station; an update based on the information I could have relayed.

I will sorely miss my friend John, as will many. He was a very good man. Unfortunately for me, I will now have to live each day with the unanswered question, *"Did I help kill my best friend?"*

MSgt. Pendergest enlisted in the Air Force in 1968. He graduated from Weather Technician School in 1974 and spent ten years forecasting weather at several Air Force bases in south Texas. Prior to his present assignment to USAFETAC at Scott AFB, IL, he was MAC Technical Advisor to the 182d Weather Flight, Texas Air National Guard.

# Gross Navigation Errors

**You're the key.**

"Bozo 73, this is Shannon."

"Go ahead Shannon, Bozo 73."

"Bozo 73, Shannon, squawk 5327, ident."

"5327 ident, Bozo 73."

"Bozo 73, this is Shannon, you are radar identified 60 nm north of track, are you having any difficulties?"

"Shannon, Bozo 73, we show our position as 53N/15W on both INSs which agrees with our flight plan."

"Bozo 73, Shannon, your position is confirmed, however, we show your route of flight as 54N/30W, 53N/20W, 52N/15W, instead of 53N/15W. Sir, please be advised that we'll have to file a gross navigation error report. You are in conflict with Air France Flight 326 which is estimating 53N/15W at 0637 Zulu."

Unfortunately, this scenario, or one similar, has been played out all too often in the recent past. Of 33 gross navigation errors filed by ATC agencies against USAF crews in the North Atlantic (NAT) Region from 1 Mar 85 to 24 Feb 86, 17 were attributed to MAC aircrews. For each 10,000 observations (approximate number of USAF operations), the Minimum Navigation Performance Specifications (MNPS) criteria allows 5 errors of 30 nm or more and only one error which is within 10 nm of a multiple of the separation standard (50-70 nm, 110-130 nm, etc). During the period 1 Mar 84 to 28 Feb 85, the USAF had 6 errors. Since 1 Mar 85, the USAF committed 13 errors of 30 nm or more and 7 separation standard errors. This has greatly concerned the international community, the DOD, and ICAO states that monitor flight safety in the North Atlantic. Remember, *every* MAC airplane operating in the North Atlantic is covered by its own MAC 55-xx series regulation. *You don't have to be operating in MNPS airspace to be violated.* That 25-mile error can happen in a hurry. The following brief summaries of these events list *what* happened. Some of the *whys* are still under investigation.

- 9 Feb 86—C-141 enroute from Dover to RAF Waddington. Shanwick reported the aircraft 40 nm off course. The crew said they were cleared for new routing. Shanwick is investigating a possible communications conflict between Oceanic and Domestic control. Investigation in progress.
- 8 Feb 86—C-141 outbound from McGuire. Possible 88 nm error over the North Atlantic. The crew reported the INS would not accept TACAN or manual updates. All present position and waypoint data were verified prior to flight. Investigation in progress.
- 8 Feb 86—C-130 on a navigator training leg from Bermuda to a base in the Northeast US. ARTCC radar did not agree with the navigator's plot. The nav reported good Omega, Doppler, and pressure during the previous seven hours of flight. Preliminary finding: Navigator celestial procedures were poor. Investigation in progress.
- 7 Feb 86—A C-130 enroute from Mildenhall to Goose Bay was reported 60 nm off course. Skies were overcast the three previous hours. The Omega did not lock on for the entire flight. The Omega status

report for the period verified one station was off the air and another was transmitting on low power. Preliminary finding: The primary compass system appeared to be drifting. Investigation in progress.

- 15 Jan 86—A C-141 enroute from McGuire to Sondestrom was reported 60 nm off course. Possible INS problems. Investigation in progress.
- 22 Dec 85—A C-141 enroute from Seville to McGuire was reported 115 nm off course. The crew verified an INS programming error.
- 30 Nov 85—A C-141 enroute from Ramstein to McGuire was reported by Moncton Center to be 27 nm off course. The aircraft commander failed to complete an Oceanic Planning Chart and experienced problems programming an amended clearance into the INS from the FSAS. The crew did not monitor flight progress with radio aids.
- 27 Nov 85—A C-141 enroute from Lajes to McGuire was reported 120 nm off course. The crew experienced problems programming the INS from the FSAS. The crew elected to fly a VOR radial outbound but plotted the radial from the wrong VOR.
- 25 Oct 85—A C-141 enroute from Frankfurt to McGuire was reported 60 nm off course by Gander. A waypoint was entered in error by the copilot and not detected by the pilot. The pilots failed to crosscheck all available information and detect a turn to an incorrect heading.
- 9 Oct 85—A C-130 enroute from Mildenhall to Goose Bay was reported 150 nm off course. The navigator flew a practice grid navigation leg and applied grivation in the wrong direction. This resulted in a 7° heading error. His celestial fixes were also in error due to inaccurate grid computations. The crew diverted to Keflavik.
- 27 Aug 85—A C-141 enroute from Shaw to Alconbury was reported 60 nm off course. The Flight Plan track was: CYQX 51N/50W 53N/40W. The cleared track was: CYQX 50N/50W 53N/40W. The unit was notified of the alleged violation two months after the fact. The crew did not remember the clearance change. Supervisors were unable to obtain tapes from Gander to verify the violation.
- 26 Jul 85—A C-130 enroute from Travis to Hickam was reported 55 nm off course by Honolulu Center. The aircraft's autopilot would not maintain heading and the crew experienced Doppler and pilot's BDHI malfunctions. Erratic heading changes also precluded pressure navigation. Celestial lines of position were erroneous. The Omega was in DR mode due to being reset from celestial fixes.
- 29 May 85—A C-141 enroute from Mildenhall to Goose Bay flew, according to Shanwick, to 57N/20W when originally cleared to 58N/20W. No actual violation. The crew apparently misidentified two waypoints by 1° latitude error. They were recleared in both cases but would have been violated had the controller not caught the misidentification on their position reports.
- 25 May 85—A C-130 enroute from Goose Bay to Brize Norton was reported by Shanwick to be 60 nm off course. Doppler, Omega, pressure pattern, and day celestial were used for navigation. The navigator allowed the aircraft to deviate off course. Pressure pattern and Doppler indicated on course. Celestial lines of position and Omega indicated right of course just prior to the reported deviation.
- 21 Apr 85—A C-5 enroute from Dover to Ramstein was reported by Gander to be 120 nm off course. The crew reported radio problems and stated (when notified of the error) they had reverted to an old flight plan, thinking Track Whiskey had expired.
- 7 Apr 85—C-130, unit unknown. Unable to identify the aircraft and aircrew.
- 29 Mar 85—The C-5 aircraft commander in the right seat (copilot was in the left seat on this leg) concentrated his attention on INS #2 indications even though the #2 CDI was known to be malfunctioning. The copilot was in the bunk at the time of the violation. The #1 CDI showed the aircraft off course.

**Gross Navigation Errors**

A "gross navigation error" is internationally defined as an unauthorized deviation of 25 nm or more from the exact centerline of the route of flight assigned by ATC. *The primary air traffic service is the prevention of collision. When you accept an ATC clearance, you are agreeing to operate the aircraft so as to always remain within the area assigned by ATC.* This is of paramount importance in oceanic areas since ATC does not have independent knowledge of your actual position and must depend entirely on your position reports to identify potential

conflicts. In NAT/MNPS airspace, the ATC lateral separation minimum is 60 nm. Acceptance of an ATC clearance means you have agreed to remain within 30 nm of the exact centerline of your assigned route of flight. If you alter your route of flight by 30 nm or more, you have deviated from your "protected" airspace and may have blundered into another aircraft's "protected" airspace, creating a collision hazard.

**Causes**

During the early days of NAT/MNPS, the MAC fleet transitioned from manual navigation (using doppler, LORAN, pressure pattern, celestial, and dead reckoning) to automatic electronic long-range navigation systems such as INS and OMEGA. This transition significantly improved the accuracy and reliability of navigation. However, as a direct result of this transition, the character of MAC gross navigation errors changed from random errors due to position uncertainty to navigating very precisely to the wrong place due to misunderstandings and/or mismanagement of automated systems. Although the number of MAC formal navigation errors were reduced following this transition, the current trend is unacceptable and could lead to restrictions on MAC's use of the organized track system.

Some of the significant factors which contribute to MAC gross navigation errors are:

- Inadequate understanding of ATC clearance changes (flew flight plan route).
- Operational procedures not compatible with MNPS operation (autopilot not coupled to the INS/OMEGA, flying headings provided by the navigator).
- Inadequate mission planning (failure to adequately crosscheck flight plan against track message).
- Inadequate crew coordination (ATC clearance not common knowledge in the cockpit).
- Inadequate operating procedures for crosschecking navigation equipment (incorrect waypoint programmed).
- Inadequate cockpit documentation (track message not available to the crew, computer flight plan not compatible with NAT structure).
- Inadequate understanding of MNPS operational requirements (not obtaining oceanic clearance prior to entry).

Further analysis of USAF and MAC errors shows three relatively distinct groups. In one group, the navigation equipment is operating properly with an incorrect waypoint or route of flight programmed by the flight crew. In the other group, the navigation equipment is properly programmed but is not used as the primary steering reference; the aircraft is flying headings while the navigator practices manual navigation. The last group, of course, is equipment malfunction.

Navigation by manual means cannot meet MNPS requirements. This was the primary reason for the creation of MNPS and the necessity of automated equipment to meet these requirements. Manually steering the INS/OMEGA is inadequate to meet the MNPS, especially if the cross track information is not presented to the pilots on the HSI/CDI creating the need for pilots to fly headings provided by the navigator. Although a single INS or single OMEGA combined with a navigator may have the accuracy necessary to meet MNPS, the operational procedures applied to their use do not meet the overall performance requirements of MNPS.

**THE BOTTOM LINE**

The record of navigation errors over the North Atlantic clearly shows that even the most highly experienced crews are involved in gross navigation errors and there is some evidence that highly experienced civil crews make these mistakes more frequently than civil crews new to the NAT system. It could be that familiarity breeds complacency since many of the errors have subtle causes. Use the Oceanic Plotting Chart religiously, it's intended to provide a check against inadvertent INS/OMEGA data entry errors. A moment's inattention is all that's needed to set the trap.

The most important thing to remember is that safety of flight over the North Atlantic is totally dependent on your performance and professionalism. *The system is only as safe as you are.*

Information courtesy of: HQ USAF/XOORF and HQ MAC/DOV.

# No Sweat

by Capt. Michael J. Iltis
Associate Editor

As summertime approaches, those of us in the northern hemisphere begin looking forward to the pleasurable aspects of warmer temperatures and longer days. Unfortunately, these same pleasant environmental factors introduce an element of potential disaster for aircrews—high temperature-induced thermal stress and fatigue.

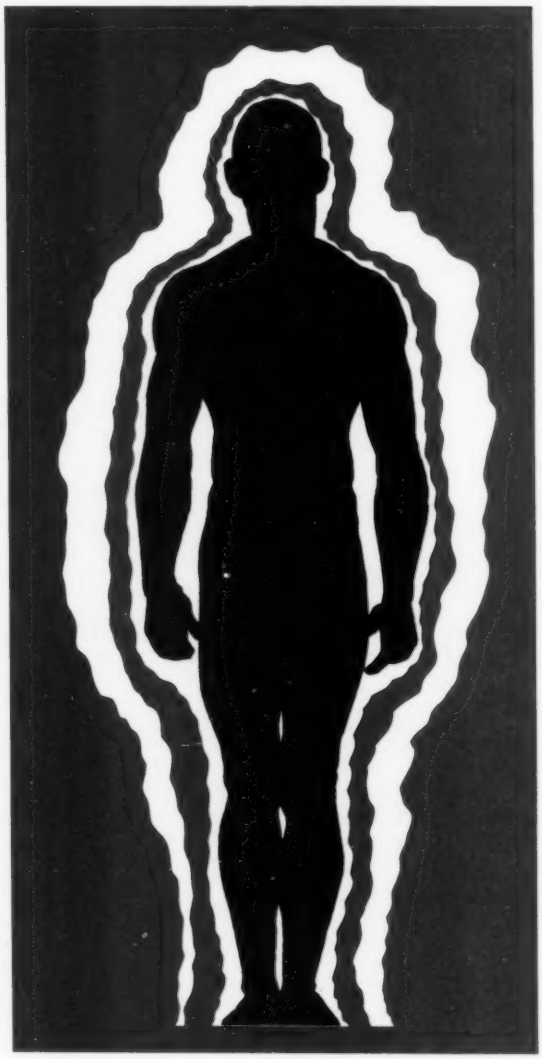
Though air conditioned cockpits and crew compartments of *some* aircraft reduce effects of thermal stress on aircrews during flight, the scope of MAC's tactical air and ground operations expose MAC crewmembers to a variety of climates. With this in mind, it's appropriate to take a look at some heat-related hazards, their effects, and what we can do to improve our performance in hot weather.

From a mechanical viewpoint, the body is nothing more than a machine, processing fuel, converting it to heat, and finally transforming it to potential and kinetic energy. Integral to this process is the machine's ability to maintain homeostatic internal temperature control within certain limits. (In humans the standard is approximately 98.6°F.) If the temperature varies, either on the high or low side, work output decreases or the machine fails completely. To avoid this, the body provides its own natural means of dissipating heat. In his article, "Heat," Col. Stanley J. Pala, HQ MAC/SGPA, relates this cooling process to that of an automobile engine:

". . . An engine produces great amounts of heat, just as the body does. This heat is eliminated by means of the cooling system—water, usually—just as the blood does in the body. This hot water (blood) is moved through hoses (arteries) by the water pump (heart) to the radiator which acts much as our skin does in dissipating heat. The thermostat (our brain) regulates this process to keep the temperature at the optimum level. When any part of this system breaks down, heat rapidly builds up and the engine may be ruined."

The cooling system breakdown which

**Thermal Stressors**



Colonel Pala refers to may be caused by salt and/or water depletion, or from the failure of the evaporative cooling process.

**Salt/Water Depletion**

The ability of the body to maintain adequate hydration is dependent on the amount of evaporative cooling (sweating) taking place in proportion to the amount of water consumed and the salt content of the perspiration. When dehydration results from salt depletion, water alone cannot relieve the condition because water cannot replace the salt necessary for cellular and hormonal balance.

Relative humidity plays an important role in reducing water/salt levels in the body. As relative humidity increases, evaporative cooling of the body is decreased while water/salt loss through sweating is increased. Simply stated, if perspiration on the skin doesn't evaporate, the heat exchange from the body to the atmosphere isn't complete. The body attempts to compensate for this by increasing the volume of sweat produced. This is especially important for unacclimated persons because the salt content of their perspiration is higher than those who are acclimated.

When dehydration results from water depletion, the cure is simple—replace the water. Unfortunately though, many people are unaware that many of the liquids commonly used as thirst-quenchers have just the opposite effect. For instance, beverages containing caffeine such as coffee, tea, and some soft drinks act as diuretics and actually speed the dehydration process. In the final analysis, nothing replaces fluid in the body better than good old water.

Whether caused by the loss of salt or water, dehydration can cause heat cramps and/or heat exhaustion which can lead to more serious forms of heat stress.

O Heat Cramps. This illness may occur by itself or in combination with other, more severe illnesses. It manifests itself as cramps in the voluntary muscles. The muscles of the extremities and the abdominal walls are most likely to be affected. This condition is usually caused by electrolyte depletion. Experienced by itself, this condition is painful but the least serious of all heat-related illnesses. Treatment consists of replacing the salt lost through sweating.

O Heat Exhaustion. Like heat cramps, this illness may occur by itself or in concert with other heat-related distress. It will probably be associated with heat cramps. Heat exhaustion results from the loss of either salt or water in the system. Symptoms of this condition include headache, mental confusion, vertigo, loss of coordination, drowsiness, extreme weakness, loss of appetite, vomiting, and visual disturbances. Blood pressure is elevated and the skin is cool. The individual sweats profusely. A person experiencing this type of disorder should be moved to a cool area to rest. Any action which serves to lower the blood pressure is advisable. Elevating the feet while lying down as well as massaging the extremities may help. Water/salt depletion may be remedied by drinking large amounts of salt solution (one-half teaspoon of salt per one quart of water).

Though neither heat cramps nor heat exhaustion are normally fatal, their potential impact on crewmember performance and flight safety is obvious. The insidious nature of these illnesses should not be overlooked. For instance, a crewmember who's responsible for strenuous preflight duties may deplete necessary water/salt reserves. The uncomfortable manifestations of this loss may not be felt until later in the flight as he/she continues to sweat and salt/water levels reach the critical point.

**Cooling System Failure - Heat Stroke.**

Heat stroke is deadly. The chance of death from this condition is high if left untreated for long. This illness results from the complete failure of the body's cooling system. Generally, its symptoms include those related to heat exhaustion with several exceptions; there is a notable *absence* of sweating and the skin is hot and red. A person suffering from heat stroke will normally lose consciousness immediately or soon after its onset. *Body temperature must be lowered immediately!* This is best accomplished by removing the clothes and immersing the person in cool water. If this is impossible, sprinkle water over the victim or wrap the body with cool and damp cloth. Just as with heat exhaustion, massaging the extremities will help to lower blood pressure and promote heat exchange from the blood through the skin.

**Fatigue**

Possibly the *most* dangerous heat stress illness for aircrew members is the one which most medical manuals list as the least dangerous—Heat Fatigue. Heat Fatigue may present itself as either transient or chronic.

Transient Heat Fatigue normally occurs in people not acclimated to the hot environment. This disorder reduces performance of skilled sensorimotor, mental, or vigilance tasks such as those associated with normal aircraft operations. Symptoms include general discomfort and physiological strain. There is no medical remedy required unless it is associated with other varieties of heat related illness.

Chronic Heat Fatigue is similar to Transient Heat Fatigue except that it is more long-lasting. Its effects may include irritability and lowering of self-imposed social standards. If the condition persists, medical treatment may be required.

Remember, both of these types of heat fatigue subtly affect performance of routine tasks. Like hypoxia, you must recognize your symptoms before a minor miscue turns into a major disaster.

**So What Can I Do?**

Minimizing the effects of heat stress and avoiding the major heat-related illnesses is a matter of acclimatization and recognition of the early symptoms.

Acclimatization is a relatively slow process which aircrews transiting from a temperate or cold environment to a hot one may not be able to take advantage of. Basically, the body requires up to three weeks to adjust to hot weather. Blood vessels expand, allowing for increased blood circulation through the skin, promoting heat exchange. Sweating becomes more efficient and the sodium content of perspiration decreases. For this reason, acclimatized persons *normally* don't require supplemental salt other than that used in their daily diet.

The unacclimatized person will probably require supplemental salt for the first two weeks after exposure to hot weather, depending on physical activity. If supplemental salt is needed,the best method is to increase the amount of salt in the daily diet or add it to drinking water. Though salt tablets eventually give the desired results, they can also cause problems. In fact, plain salt tablets use cornstarch as a disintegrating agent. The tablets dissolve quickly and salt, in concentrated form, is **not** rapidly absorbed into the blood. This concentration of salt in the stomach may cause gastrointestinal discomfort.

Even if you are placed in a situation which doesn't allow proper acclimatization, there are some things you can do to improve your body's ability to cope with the heat. First, develop a good physical fitness program. This may promote acclimatization. As a person exercises, the body begins adjusting itself to compensate for the heat created by strenuous physical activity. The best type of exercise to prepare you for hotter temperatures is that which stresses the cardiovascular system as opposed to that which builds muscular power, e.g., running rather than weightlifting. Physically active people removed from cold climates to hot ones adjust much easier than inactive people.

Secondly, recognize that performance levels are reduced and the demand for water increased in hot temperatures. Don't push yourself. The body will require more water in order to remain hydrated—make sure it gets it. The old axiom, "Don't conserve water, conserve sweat," applies. Whenever possible, complete physically demanding crew duties in the cooler morning or evening hours. Also, the clothing you wear plays an important part in your body's ability to dissipate heat. Though clothing generally helps reduce exposure to solar rays, it also reduces evaporative cooling. For this reason, the best clothing in hot temperatures is clothing that is loose-fitting and porous to allow for air circulation.

The demands placed on MAC crewmembers to respond anywhere at any time make them very vulnerable to the effects of heat stress. Not only are we susceptible to debilitating heat illnesses, but long crew duty days and tactical and ground operations promote the insidious and potentially disastrous effects of heat fatigue. Knowledge of this problem, along with some simple steps to reduce heat stress, will help us get the job done right every time —*no sweat.*

References: *Aeromedical Handbook For Aircrew* by T.G. Dobie

*US Naval Flight Surgeon's Manual*

AFP 160-1, *The Etiology, Prevention, Diagnosis, and Treatment of Adverse Effects of Heat*

*Heat* by Col Stanley J. Pala

# The Human and The Mishap

Good morning, Mac, can I pour you a cup?" asked Capt. Bruce Billingsley as he poured himself a cup of freshly brewed decaffeinated coffee.

"Thanks, Bruce," said Capt. Brad "Mac" MacKenzie as he set his briefcase on the conference room table.

"This Flight Safety Officer conference was a great idea," said Bruce. "It's a good chance to brush up on some of the things we don't get to address too often at the wing. What's the topic this morning?"

"I thought we'd go over some human factors that can be associated with a mishap and how they relate to one another," Mac replied.

"Sounds interesting," Bruce responded. "Here come the rest of the folks now."

"Good morning, everyone," Brad began. "As I was telling Captain Billingsley before you arrived, this morning we'll analyze human factors associated with aircraft mishaps. Though the human factor is only one part of any mishap, recent experience has shown that human factors play a greater part in causing mishaps than other factors.

"We'll focus on physical, physiological, pathological, psychosocial, and psychological attributes.

"Physically, we need to examine whether the pilot or other crewmembers involved in a mishap was able to reach, manipulate, and monitor all necessary controls, switches, and displays. We can examine and determine, right now, if improvements or modifications can be made to cockpit or panel layouts. We can expect however, that most individual crewmembers are 'normal.' That is, physical attributes don't *usually* contribute to the cause of most mishaps.

"Physiological aspects present a more complicated and varied picture that require thorough investigation. Again, most crewmembers are relatively free of any limitations that would hinder ability to perceive sensory stimuli. A review of medical records should normally reveal any problems in that area.

"The stimuli present at the time of the mishap call for careful analysis. Outside visual cues may be limited by darkness, clouds, or precipitation. Also, consider whether outside visual cues were required at all. Inside visual cues may have also been

impaired, so investigate visual acuity, focus time, and light adaptation.

"The flight surgeon will normally examine the mishap crewmembers' activities and habits. However, as an investigator, you should know the effects nutrition, hydration, transient/acute and chronic/cumulative fatigue can have on an individual's behavior and performance. Some of these factors may be related to hypoxia, hyperventilation, decompression sickness, and trapped gas effects. The disruption of eating and sleeping cycles (circadian rhythms) due to time zone changes can play a big part in a crewmember's efficiency and should always be examined.

"There are two pathological aspects we need to look at when examining the human factors portion of a mishap. Organic pathology of course will include toxicological testing for prohibited, non-prescribed, and prescribed substances. The side effects of any substances must be evaluated in relation to the crewmember's duties.

"Functional pathology deals with the lifestyle and events in the life of the person involved. It will also include examination for neuroses, psychoses, conduct and character disorders, and substance abuse. Suicide can *normally* be ruled out but should be considered.

"The psychosocial aspect is characterized by interactive behavior. This includes both familial and professional factors. Familial factors will cover marriage difficulties, significant life stresses, financial, legal, or religious problems.

"Professional factors can cover a wide range of possibilities. Recent promotions or passovers, new duties, additional duties, being removed from a position, career progress or lack of it, upcoming PCS or TDY, upgrades or downgrades in crew position, can all cause undue pressure on the crewmember. These factors can also contribute to subjective fatigue which is fatigue brought on by self-imposed stress.

"Psychological factors encompass the individual's independent behavior, traits, and capacities. Try to get a picture of the person's stability, maturity, aggressiveness, and competitiveness. Attention anomalies can occur which may directly contribute to a mishap. These can be divided into two types, channelized attention and inattention. Inattention to some detail or part of the environment has played a role in many mishaps. It is usually described as a reduced state of conscious attention, secondary to a perceived non-threatening environment and may be general or selective in degree. One factor may be selectively inattended to, such as terrain, weather, etc., or most things may be inattended to, (basically, daydreaming). This shouldn't be confused with what we call 'complacency.'

"Motivation plays a big role in how anyone performs their job. A person may be responding to intimidation and attempt to perform a risky task, or the individual may just be a risk-taker. Therefore, being motivated to attempt a hazardous maneuver or mission based on peer or supervisory pressure

"Motivation plays a big role in how anyone performs their job."

is a possibility. However, the most probable motivation is that the individual is just trying to get the job done. This may contribute to selective inattention to the relationship of the airplane to some part of the environment, terrain for example, and contribute to the cause of a mishap.

"Learning, or learning anomalies, can contribute to a mishap in several ways. We learn through training or experience. A person may be very well trained in the overall sense but may have little training or experience in a particular operation or task. Prior success at a task in which a crewmember is basically inexperienced can lead to a false sense of security. Knowledge that others have performed the task successfully shortly before your attempt can also generate a feeling of security. This was evident in several windshear accidents, where airplanes preceding the mishap airplane took off or landed with little or no difficulty.

"Proactive inhibition, more commonly called habit-pattern interference, may be another aspect of learning relevant to a mishap. Switching from standard to non-standard procedures or techniques, or vice-versa, has caused mishaps in the past. Other things causing interference have been radio

calls, intra-cockpit communications, and unusual requests from ATC. The infamous 360° or 270° turn on downwind and the eventual gear-up landing is a classic example.

"Mishap investigation, especially of the human factors involved, is a complex undertaking. As part of this undertaking, we must also consider the individual in relation to his or her environment. Let's look at some parts of the environment that have contributed to the cause of a mishap.

"The entire crew will be examined in light of my earlier discussion but there are some other aspects we need to look at. In a multiplace aircraft, other crewmembers' experience can play an important part in a mishap. Due to MAC's method of operation, crewmembers of different experience levels are often crewed together to perform a mission. You may have an experienced AC, but an inexperienced copilot or navigator. New copilots may not have developed a strong sense of crew coordination or situational awareness. Weaknesses in these areas could lead to task saturation and make them less apt to monitor parameters that are vital, but not directly associated with, the particulars of the task at hand.

"Motivation and habit-pattern interference can affect a whole crew as well as one individual. Performing a 'standard' task in the 'normal' way may not fit the way that task needs to be done in a 'nonstandard' environment. Put another way, what is normal and accepted procedure at home base may have dangerous implications if that procedure is applied in a new location.

"Of course, no mishap can be investigated without considering the aircraft involved. Was it mechanically sound? Was it properly equipped for the mission? Were there any malfunctions that would incapacitate or distract the crew during execution of the mission? The specifics of examining wreckage aren't within the scope of today's discussion, but the airplane, and how the crew related to it, are vitally important.

"Weather can often be the most hostile part of a crew's environment. Thorough consideration of weather conditions in relation to the airplane's limits, the crew, and the mission is essential. Was the weather better or worse than forecast? What were the actual conditions at the time and place of the mishap? Were visual cues required to perform the part of the mission being flown at the time of the mishap? Was there sufficient light available for the crew to properly interpret what they *could* see?

"The mission itself may be a causal factor. Was it demanding or relatively simple? Was it demanding for part of the crew and simple for everyone else? Were the affected crewmembers experienced enough to handle it? Crewmembers can become complacent if they've done the same mission often enough for it to become routine. Complacency and inexperience may unite to form a deadly combination.

"Agencies that supply services and information to the crew can often contribute to a mishap. Were pallets weighed correctly? Was the weather forecast accurate? Were maps and charts accurate? Crewmembers must assemble and correlate data from a multitude of sources. Each of those sources has the potential to supply erroneous or misleading information. Unfortunately, the crewmember doesn't usually have the opportunity to determine the accuracy of *all* the information supplied. That job often gets left to the mishap investigator.

"Lastly, the guidance put forth in publications and directives, and supplied by supervisors, may have contained a degree of ambiguity regarding the procedures to be used for a particular mission. Experience and ingenuity can sometimes overcome ambiguous guidance, but inexperience and complacency have too often combined to cause a mishap. Look at the guidance you're getting for your particular mission. Clear, unambiguous guidance and procedures must be our objective. Some time spent giving your regs a critical review now may prevent a mishap later.

"The human factor is causing a higher and higher percentage of the Air Force's mishaps. Careful and systematic attention to each part of an individual's physical, physiological, pathological, psychosocial, and psychological make-up, and how they relate to the environment, can help you put the pieces of the puzzle together and prevent that next mishap. Remember, *prevention is our business.*

"Well, I'm sure you're all ready for a break. Let's take 20 minutes and, when we come back, we'll talk about midair collision avoidance programs."

# Close Encounter

by Prof. John Wise

**Up close and personal.**

*(Editor's Note*--This time of year all aviators are bombarded with warnings about the hazards of thunderstorms. But we don't often get firsthand knowledge of what it's like to encounter a thunderstorm on a personal, intimate level. The following account by an early aviator, Professor John Wise, Carlisle, PA, should be enough to convince even the most doubtful.)

According to announcement, I started on Saturday last on my forty-first excursion from the Center Square of Carlisle, Pa. at precisely fifteen minutes past two o'clock in the afternoon, it being the 17th of June, 1843. A slight breeze from the west wafted me a short distance in its direction, horizontally, after which the ascent became nearly perpendicular until the height attained was about twenty-five hundred feet, when the balloon moved off toward the east with a velocity much greater than that of its ascent. When I had reached a point about two miles east of the town, there appeared a little distance beyond and above me, a huge black cloud. Seeing that the horizontal velocity of the balloon would carry it underneath and beyond the cloud, preparations were at once made to effect it by throwing out some ballast as soon as its border should be reached. Harrisburg was now distinctly in view, and the balloon moving directly for it; I was hesitating, with the bag of ballast in hand, whether I should throw it out for the purpose designated, or continue straight on as I was then going to the place just mentioned. By this time I had reached a point underneath the cloud, which was expanding, and immediately felt an agitation in the machinery, and presently an upward tendency of the balloon, which also commenced to rotate rapidly on its vertical axis. I might have discharged gas and probably have passed underneath it, but thinking that it would soon be penetrated, and then might be passed above, as it appeared not to be moving along itself, I made no hesitation in letting the balloon go on its way.

The cloud, to the best of my judgment, covered an area of four to six miles in diameter; it appeared of a circular form as I entered it, considerably depressed in its lower surface, presenting a great concavity toward the earth, with its lower edges very ragged and falling downward with an agitated

motion, and it was of a dark smoke color. Just before entering this cloud, I noticed, at some distance off, a storm cloud from which there was apparently a heavy rain descending. The first sensations I experienced when entering this cloud were extremely unpleasant.

The cold had now become intense, and everything around me of a fibrous nature became thickly covered with hoar-frost, my whiskers jutting out with it far beyond my face, and the cords running up from my car (the balloon basket) looking like glass rods, these being glazed with ice, and snow and hail was indiscriminately pelting all around me. The cloud, at this point, which I presumed to be about the midst of it from the terrible ebullition going on, had not that black appearance I observed on entering it, but was of a light, milky color, and so dense, just at this time, that I could hardly see the balloon, which was sixteen feet above the car. From the intensity of the cold in this cloud I supposed that the gas would rapidly condense, and the balloon consequently descend and take me out of it. In this, however, I was doomed to disappointment, for I soon found myself whirling upward with a fearful rapidity, the balloon gyrating and the car describing a large circle in the cloud. A noise resembling the rushing of a thousand milldams, intermingled with a dismal moaning sound of wind, surrounded me in this terrible flight. Whether this noise was occasioned by the hail and snow which was so fearfully pelting the balloon, I am unable to tell, as the moaning sound must evidently have had another source. I was in hope, when being hurled rapidly upward, that I should escape from the top of the cloud; but as in former expectations of an opposite release from this terrible place, disappointment was again my lot, and the congenial sunshine, invariably above, which had already been anticipated by its faint glimmer through the top of the cloud, soon vanished with a violent downward surge of the balloon, as it appeared to me, of some hundred feet. The balloon subsided, only to be hurled upward again, when, having attained its maximum, it would again sink down with a swinging and fearful velocity, to be carried up again and let fall. This happened eight or ten times, all the time the storm raging with unabated fury, while the discharge of ballast would not let me out at the top of the cloud, nor discharge of gas out of the bottom of it, though I had expended at least thirty pounds of the former in the first attempt, and no less than a thousand cubic feet of the latter, for the balloon had also become perforated with holes by the icicles that were formed where the melted snow ran on the cords at the point where they diverged from the balloon, and would by the surging and swinging motion pierce it through.

Once I saw the earth through a chasm in the cloud but was hurled up once more after that, when, to my great joy, I fell clear out of it, after having been belched up and swallowed down repeatedly by this huge and terrific monster of the air for a space of twenty minutes, which seemed like an age, for I thought my watch had stopped, till a comparison of it with another afterward proved the contrary. I landed, in the midst of a pouring rain, on the farm of Mr. Goodyear, five miles from Carlisle, in a fallow field, where the dashing rain bespattered me with mud from head to foot as I stood in my car looking up at the fearful element which had just disgorged me.

The density of this cloud did not appear alike all through it, as I could at times see the balloon very distinctly above me, also, occasionally, pieces of paper and whole newspapers, of which a considerable quantity were blown out of my car. I also noticed a violent convolutionary motion or action of the vapor of the cloud going on, and a promiscuous scattering of the hail and snow, as though it were projected from every point of the compass.

Reprinted from *WEATHER AND FLIGHT*

HQ USAF/IG
Washington DC 20330-5100
5 March 1986

General Duane H. Cassidy
Commander in Chief
Military Airlift Command
Scott AFB IL 62225-5001

Dear General Cassidy

I'm enclosing the citation for the Chief of Staff Special Achievement Award that General Gabriel presented to you at Corona Palm.

Nineteen-eighty-five was an outstanding year for flight and ground safety in the Air Force and especially for the Military Airlift Command. None of these records could have been set without the dedicated efforts of the men and women of MAC. I share your great pride in all the men and women of the Military Airlift Command who made 1985 the safest year in its history.

Once again, congratulations on receiving this award and the outstanding achievements that made it possible.

With great respect

Bob

ROBERT D. SPRINGER
Lieutenant General, USAF
The Inspector General

CITATION

TO ACCOMPANY THE AWARD OF

THE CHIEF OF STAFF SPECIAL ACHIEVEMENT AWARD

The Chief of Staff Special Achievement Award is presented to the Military Airlift Command for outstanding flight and ground safety accomplishments during 1985.

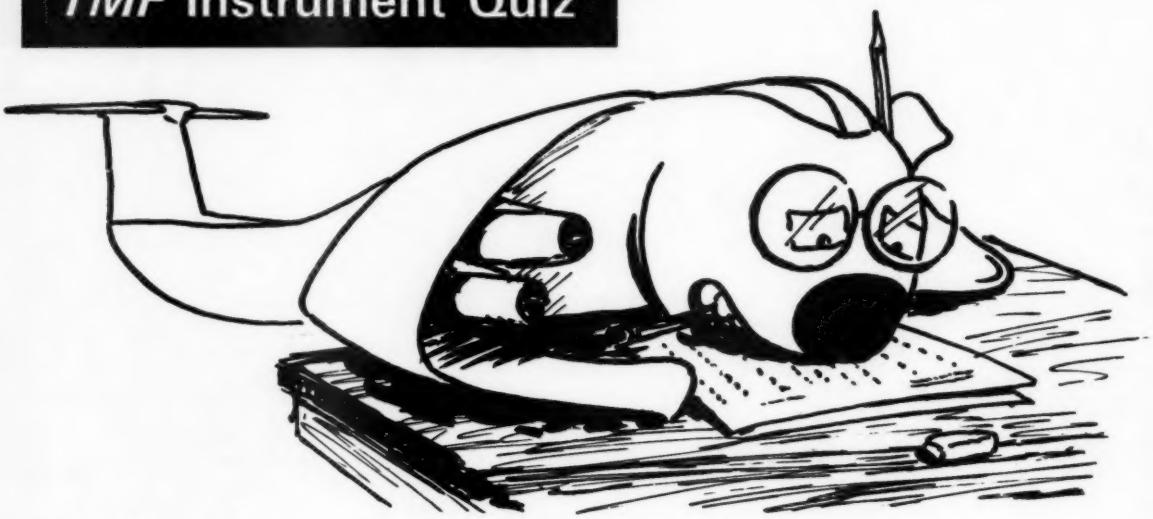
The Military Airlift Command reduced its Class A and Class B aircraft mishaps by 50 percent and 25 percent respectively from 1984. This impressive record was achieved while flying more than three-fourths of a million hours in support of the global airlift mission. Additionally, the Command reduced its ground mishap fatalities by 50 percent--the second lowest number of fatalities in its history. The superior performance of the men and women of the Military Airlift Command shows clearly their professionalism and commitment to safety.

The achievements of the Military Airlift Command exhibit high standards of safety and mission accomplishment and reflect great credit upon the Command and the United States Air Force.

Charles A. Gabriel

CHARLES A. GABRIEL, General, USAF
Chief of Staff

# *TMF* Instrument Quiz



Okay, folks, it's time to get down to brass tacks and *really* test your *closed book* knowledge of some rather important flight publications, (AFR 60-16 and AFM 51-37). You can look up the answers (weak) but keep in mind you may not have that luxury when confronted with these situations in the air. So, let's review a few areas you might need to brush-up on before they brush-up against you during a critical phase of flight.

1. Deviations from the provisions of AFR 60-16 are _____.

a. authorized when necessary to comply with a MAJCOM training directive with prior HQ USAF approval

b. not authorized

c. authorized by your DO

d. authorized provided ATC issues the appropriate clearance

2. Clearance authority for flights conducted under IFR in uncontrolled airspace _____.

a. rests with ATC

b. rests with the pilot

c. rests with the unit commander

d. rests with the unit DO

3. Except for formation and certain Command approved maneuvers, pilots will not fly an aircraft so close to another so as to create a collision hazard. Normally, use _____ separation (well clear) as an approximate guide.

a. 500-foot

b. 1,000-foot

c. 50-foot

d. twice the wingspan for

4. A C-141 aircraft commander is filing to a destination serviced only by a circling approach. Published ceiling and visibility minimums for this approach are 600 feet and 2 miles respectively. What must the forecast ceiling and visibility be (for your ETA plus or minus 1 hour) in order to file to this destination?

a. 600-foot ceiling, 2 miles visibility.

b. 2 miles visibility.

c. 600-foot ceiling.

d. Enough visibility for the crash trucks to respond.

5. Suppose you're filing to the same destination, using the same fixed-wing approach. Your flight will be in a helicopter. What weather forecast (for your ETA plus or minus 1 hour) is required to file to this destination?

a. 1 mile visibility.

b. 600-foot ceiling.

c. 600-foot ceiling, 1 mile visibility.

d. 600-foot ceiling, ½ mile visibility.

6. Suppose you wanted to use this same airport as your fixed-wing alternate. For planning purposes, what would the forecast weather (ETA plus or minus 1 hour) have to be in order to use this airport as your alternate?

a. 1,100-foot ceiling, 1 mile visibility.
b. 1,000-foot ceiling.
c. 1,000-foot ceiling, 3 miles visibility.
d. 1,100-foot ceiling, 3 miles visibility.

7. Same question as 6 (above) but now you're planning the same flight in a helicopter.

a. 700-foot ceiling, 1 mile visibility.
b. 1,100-foot ceiling, 2½ miles visibility.
c. 1,000-foot ceiling, 1½ miles visibility
d. Enough visibility to hover.

8. If the weather forecast for the airport that you want to use as an alternate includes an intermittent condition at your ETA which is lower than acceptable alternate weather minimums, then _____.

a. you can use the airport as your alternate because intermittent weather conditions are not restrictive for filing purposes
b. find a different alternate (that one is unacceptable)

9. If your ETA at destination, on a VFR flight plan, changes by more than _____ minutes for jet aircraft or _____ minutes for non-jet aircraft, report it to flight service.

a. 15, 30
b. 5, 15
c. 30, 45
d. 45, 60

10. When determining the visibility minimums for a circling approach, use runway visual range (RVR), runway visibility (RV), or prevailing visibility (PV), in that order, to determine if visibility is at or above that required for the approach.

a. True.
b. False.

Well? How did you fare with the questions out of AFR 60-16? If you missed more than two, you may have been well on your way to bagging an ASET exam. If you missed *any* of them while planning a mission or in flight, you may have gotten violated or, worse, placed your aircraft and crew in jeopardy.

Never fear, however, we'll give you a chance to redeem yourself by answering some *easy* questions out of AFM 51-37. Get your pencils ready and let's get down to business.

11. When performing any instrument departure, climb to at least _____ before initiating a turn unless directed otherwise by ATC.

a. 500-foot AGL
b. 400-foot above airport elevation
c. an altitude that guarantees 400 foot obstacle clearance within 1 nm either side of runway centerline
d. 600-foot AGL

12. You are flying a standard instrument departure (SID). After takeoff, the controller issues you an altitude restriction not published on the SID. Further, the controller did not give you any additional altitude restrictions. You may _____.

a. climb to the assigned altitude but must adhere to all other altitude restrictions published on the SID
b. disregard the SID altitude restrictions and climb unrestricted
c. disregard the altitude restriction given by the controller. In this case, inform the controller of your intentions
d. punt

13. The standard no-wind holding pattern is flown by following a specified holding course inbound to the holding fix, making a 180° turn to the right, flying a heading outbound to parallel the holding course, and making another 180° turn to the right to intercept and follow the holding course to the fix.

a. True.
b. False.

14. ATC clearances requiring holding, where holding patterns are charted, *must* include which of the following instructions:

a. The holding fix and direction of holding from the fix.
b. Outbound leg length in miles, if DME is used.

c. Left turns, if the holding pattern is nonstandard.

d. Both a and b are correct.

15. If you are flying a procedural track which shows a descent at the initial approach fix (IAF), start the descent when abeam or past the IAF and _____.

a. on course, inbound

b. on a parallel or intercept heading to the procedural track course

c. within 2° of course centerline

d. within 5° of course centerline

16. On final, during a non-precision approach, the controller advises he will provide "radar monitoring." This service provides altitude warning information if the aircraft descends below a safe altitude.

a. True.

b. False.

17. You are being vectored for a visual approach. The reported ceiling is at least 500 feet above minimum vectoring altitude and visibility is at least 3 miles. Your aircraft will be vectored to intercept the final approach course _____.

a. at least 1 mile from the final approach fix (FAF) at a maximum intercept angle of 20°

b. at least 3 miles from the FAF at a maximum intercept angle of 30°

c. both a and b are correct

d. none of the above are requirements

18. Beginning the visual descent for landing at the missed approach point (MAP) on a non-precision approach _____.

a. will not guarantee a normal (approximately 3°) approach angle to landing

b. will guarantee a normal (approximately 3°) approach angle to landing

c. is not recommended

d. requires the pilot to decrease airspeed on final

19. Be aware the final approach course on a nonradar final may vary from the runway heading as much as _____ (except localizer) and still be published as a straight-in approach.

a. 10°

b. 20°

c. 30°

d. 40°

20. Helicopter pilots flying a COPTER ONLY approach should not exceed _____ airspeed on the approach.

a. 110 knots

b. 90 knots

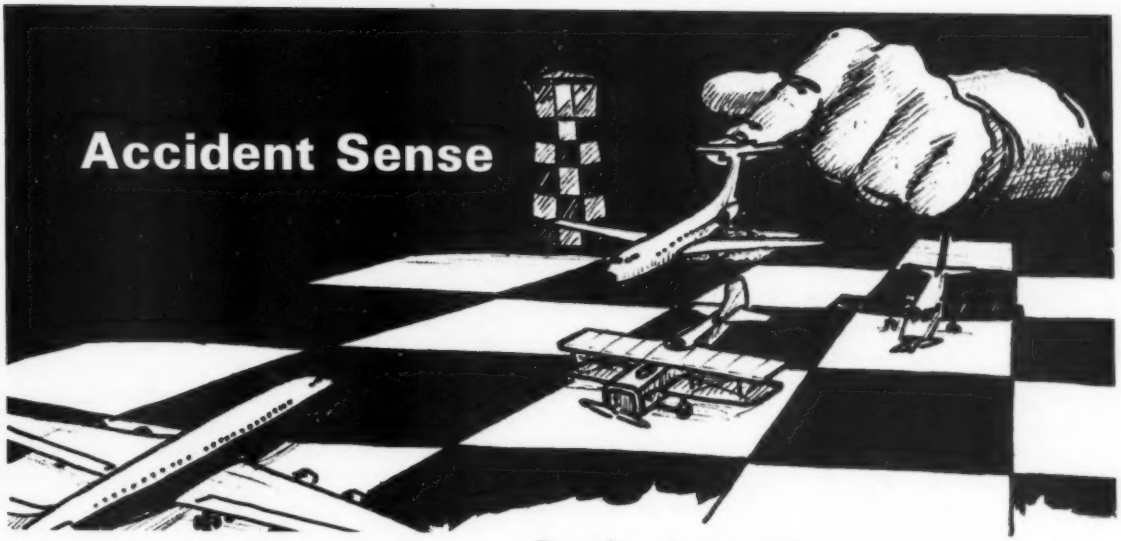
c. 100 knots

d. 80 knots

That's it! You're finished. How did you do? Our hat's off to those few who maxed the test. For those who didn't do so well, it's probably time to get back into the books. Skillful, safe flying (be it instrument or visual) is no accident. It stems from a good working knowledge of the manuals and regulations combined with air sense and crew coordination. So if you're one of those new pilots who decided that flight school ended when you received your wings, or one of those "old heads" who discovered an inch of dust has settled on your publications set, take some time to renew your acquaintence with the books—before it's too late.

ANSWERS

1. a, AFR 60-16 p. 1
2. b, " p. 12
3. a, " p. 13
4. a, " p. 24
5. c, " p. 25
6. d, " p. 25
7. b, " p. 25
8. b, " p. 26
9. a, " p. 26
10. b, " p. 27
11. b, AFM 51-37 p. 4-3
12. b, " p. 4-3
13. a, " p. 5-1
14. a, " p. 5-2
15. b, " p. 6-12
16. b, " p. 6-14.2
17. d, " p. 6-14.3
18. a " p. 6-14.4
19. c, " p. 6-14.4
20. b, " p. 6-14.4




**Develop your own.**

Gerard M. Bruggink

Although safety and accident avoidance are often considered synonymous, I prefer to differentiate the two. I see safety as a super goal, the achievement of which is governed by so many variables—including chance—that absolute control is impossible. On the other hand, the term "aircraft accident avoidance" carries the connotation that we recognize the vulnerable side of aviation. This knowledge is the basis for a practical defense mechanism. In that context, I would like to reintroduce the term "Accident Sense" which, I believe, was first used in the RAF during World War II. I define accident sense as: "The cultivated capacity to foresee and forestall the development of situations conducive to critical malfunctions and oversights."

By analyzing a few accidents, we can see how the development of accident sense might have prevented them and may prevent accidents in the future.

**B-727—Pensacola, FL**

The aircraft was flown into the water about three miles from the runway, while making a surveillance radar approach at night. The measured ceiling was 400 feet and the visibility was 4 miles with fog and haze. The minimum descent altitude for this approach was 480 feet.

While vectoring the flight through a heading change of about 150°, the radar controller provided the crew position information relative to the airport. According to published controller procedure he should have vectored the flight to intercept the final approach course at least 8 nm from the runway threshold. Actually, he did not give the final vector until the aircraft was about 5 nm from the runway; nor did he provide advance notice of the final descent point. As a result, the aircraft intercepted final about 1 nm inside the final approach fix. This caused the crew to accelerate their cockpit activities.

At this point, we recognize at least one of the classic ingredients in approach accidents: *disruption of the crew's routine in setting up a stabilized approach.* Although the controller's misjudgment did not make this accident inevitable, he certainly showed little understanding of his role in the cooperative aspects of the ATC system. It is everybody's responsibility to make it easier for others not to make an error. This requires not just skill and knowledge, but the

ability and willingness to put oneself in the other person's shoes. Only a thorough understanding of the fact that even small disruptions, annoyances, and compromises may degrade human performance will ensure the proper level of care.

There is no reason to dwell on the mechanics of the flight's descent from 1,500 feet to impact in about 1 minute. There were no altitude calls; there was no apparent awareness of the aircraft's 2,000 fpm rate of descent; the ground proximity warning system did not have its advertised effect, although it sounded for 18 seconds until it was shut off.

Before we conclude that there was nothing new in the observable elements in this accident, we should allow for the fact that we are looking only at a few end points in the man/machine relationship. Even a cockpit tape and crew testimony seldom provide more than a vague suspicion of the undercurrents and stress patterns that kept a crew from operating as a well-coordinated defensive unit. The most one can say is that such crews—individually or collectively—lacked accident sense. They did not recognize in themselves or in others, the moods and attitudes conducive to critical oversights.

**BAC 111 Landing Accident**

The flight made a precision approach in excellent daylight weather conditions. The aircraft crossed the runway threshold 61 knots above reference speed and landed nosewheel first 2,540 feet down the 5,500-foot runway at 163 KIAS. No go-around attempt was made. The aircraft was substantially damaged when it left the runway at 102 knots.

The many unusual aspects of this accident make one reluctant to attempt any type of analysis. In some respects, crew behavior was so out of the ordinary that one wonders whether they were under the spell of a cockpit contaminant or some other external factor. Had only one of them suffered a momentary problem in his physiological or psychological makeup, you would expect the other to correct the situation at the first indication that something was drastically wrong. However, the record does not reveal a firm protest during the following deviations:

- Exceeding the 250-knot speed limitation below 10,000 feet.
- Exceeding the 200-knot limitation within 5 miles of the airport and below 3,000 feet.
- Gear and flap extension at speeds well in excess of those authorized.
- Rates of descent of over 2,000 fpm within 2 miles of the threshold.
- No call outs of gross altitude, airspeed, or descent rate deviations.
- No apparent crew response to three GPWS alerts.
- No indication that a missed approach was considered, although the aircraft crossed the threshold at 184 knots ($V_{ref}$ was 123).

If any apprehension was associated with this approach it did not have its expected effect in the cockpit.

**B-727 & Cessna 172 Collision**

Only one of the enabling factors of this accident will be reviewed: the lack of protective foresight on the part of ATC and the B-727 crew. This discussion is not intended to blame individuals but to instill accident sense in the present generation of those involved in daily aircraft operations.

When the air carrier flight entered the San Diego area and began descending from 9,500 to 7,000 feet, the approach controller cleared it for a visual approach. This clearance accomplished two things:

- It put the burden of traffic separation on the flight crew.
- It allowed the pilot of the airliner to vary his altitude and flight path at will. The controller then had no altitude information to key himself to a conflict.

About two minutes later, the controller cleared the Cessna to stay on a heading that would make the light airplane cross the air carrier's downwind leg. He also instructed the Cessna pilot to maintain VFR at or below 3,500. The two airplanes collided at approximately 2,500 feet after losing sight of one another. The controller, in effect, had accepted a potential traffic conflict because he had not given the air carrier an altitude restriction. Actually, his actions were not in conflict with regulations. The point is the system introduced a risk factor that could easily have been avoided. Furthermore, the controller increased his own workload because he now had to closely monitor the

flight progress of both aircraft and issue more traffic advisories. This became the last safeguard in case the crews failed to ensure visual separation.

Our reliance on modern technology as a means of offsetting human fallibility also received a serious blow. The conflict alert warning system in the approach control facility began to sound about 19 seconds before the collision. Since the airliner crew had given the tower controller reason to believe they had the Cessna in sight, he assumed the overtaking maneuver was conducted safely, but within the triggering parameters of the conflict alert system. Unfortunately, another part of that sophisticated "safety system"—the auto-offset function—was not operating. Therefore, the altitude readouts of the two unseparated data blocks were not legible. Because of this, the approach controller could not assess vertical separation between the aircraft.

While the B-727 descended into the San Diego terminal area, the jumpseat occupant kept up a lively conversation with the captain. He continued this even after the flight had received advisories about the Cessna's altitude and track. The flight engineer started an extraneous conversation on the company radio, about a minute before the collision, while the flight was given the last traffic advisory about the Cessna by the tower. Tolerating irrelevant conversation during critical phases of flight, including descents into terminal areas, reflects little regard for the terrible price we so often pay for misplaced priorities.

ATC, as well as the flight crew, neglected a fundamental safety concept: Exploit every opportunity to make it easier for yourself and others not to make an error.

**DC-8 Fuel Exhaustion**

The aircraft left Denver with three and one-half hours of fuel, including one hour of reserve fuel. The flight from Denver to Portland was normal and the fuel consumption was as predicted. As the flight descended in the Portland area, the crew lowered the landing gear, and the retract cylinder assembly of the right landing gear failed due to corrosion of the piston rod end. This allowed the right landing gear to fall free with a loud noise and a severe jolt. The rapid fall disabled the landing gear microswitch which controls the gear-position indicators.

The crew obtained ATC permission to orbit at 5,000 feet while they accomplished the actions necessary to assure that all wheels were down and locked. The fuel consumption at 5,000 feet was 13,000 lbs per hour with the gear down and 15 percent flaps. The aircraft entered the holding pattern with approximately 13,000 lbs of fuel. One hour later, all four engines flamed out while the aircraft was still about 6 nm from the airport. The airplane crash landed.

The accident report associates the captain's failure to respond to the aircraft's fuel state and the crewmember's advisories, because of his preoccupation with the landing gear malfunction and preparation for a possible landing emergency. Although this is undoubtedly a correct assessment of what happened, it does not explain how 3 crewmembers with almost 40,000 hours of total experience would take such risks.

One speculative analysis of the crew's actions during the full hour between the start of the emergency and fuel exhaustion could be that: "Emergencies requiring an immediate and irreversible decision . . . are often handled better than those that leave time for apprehension and changes in plans."

Their knowledge of the consequences of landing with a possible gear malfunction was inadequate. They had no feeling for the accident potential in their situation, no "accident sense."

**Application to MAC**

The same factors present in these accidents exist throughout the MAC system. Crewmembers rely on each other, ATC agencies, mechanical and electronic systems on the ground and in their aircraft, and on their own knowledge and experience to do their jobs. Constant awareness of the potential for failure of any part of this interdependent system is necessary to keep it functioning smoothly. People make mistakes; machines and electronic equipment break. It's up to *you* to catch the problems before they become mishaps. *How's your accident sense?*

Adapted from *PILOT Magazine*

# Flying-Hour Milestones

Brig Gen Revere A. Young, 137 TAW/CC
MSgt Frank J. Balkum, 143 TAG
MSgt Peter L. Jannitto, Jr., 143 TAG

Col Nyles B. Courtney, 1 MAS
SMSgt Charles W. Burt, 41 MAS
SMSgt Edward G. Grubb, 41 MAS
MSgt Lance Knettle, 75 MAS
MSgt Arthur R. Rice, 312 MAS

Lt Col John W. Gurley, 185 TAS
Lt Col Roger W. Hansen, 56 MAS/CC
Lt Col Henry L. Hungerbeeler, 20 MAS
Maj Ronald Cassano, 335 MAS
Maj Walter T. Eichelberger, 193 SOG
Maj Thomas E. Hurd, 335 MAS
Maj David J. Kettela, 22 MAS
Maj Peter M. Lonngren, 335 MAS
Maj John B. Paysinger, III., Det 2, 1401 MAS
Maj Grant Price, 37 TAS
Maj Thomas G. Ritz, 335 MAS
Maj Terrence D. Williams, 345 TAS
Maj Kenneth E. Withers, 193 SOG
Capt James L. Scrabeck, 37 TAS
SMSgt Jerald E. Duffman, 57 AES
MSgt James M. Aliff, 37 TAS
MSgt Joseph F. Fiordaliso, 335 MAS
MSgt Luis A. Herrera, 20 MAS
TSgt Alfredo Roman, 37 TAS
TSgt James H. Albright, 312 MAS

MSgt Peter H. Leeds, 1551 FTS
TSgt Arthur Burkett, 1550 CCTW

Ranks and units are those at time of award. See MACR 900-3 for details on how to apply for your own milestone award.

# Crutches

by LCDR Andrew J. Peck

Webster's Third New International Dictionary (unabridged) gives one definition of crutch as "any prop, support or assisting device." Aviation is loaded with "crutches," "rules of thumb," "guidelines," and "shortcuts." FLIP manuals, AFM 51-37, the FAA's Airman's Information Manual, and other sources are loaded with information (a lot of it in formula form) that help make flying easier. The following are some handy devices for wind, altitude, speed, and other quick calculations that may reduce your workload significantly.

**Winds**

- To determine drift angle from a crosswind, or a crab angle to correct for drift: angle = (60 divided by TAS) X (crosswind). Example: 300 KTAS, crosswind component of 30 knots, drift/crab angle = 6°. Round your TAS to the nearest multiple of 30 for easy figuring.
- To figure crosswind components: one-half the reported wind at 30° off the nose, two-thirds at 45°, and six-sevenths at 60 degrees. An easy way to compute six-sevenths is to subtract 15 percent from the reported wind. Remember that surface winds in a sequence report are referenced to true north, whereas those given to you by the tower or approach control are magnetic—which is what we're really concerned with.
- Winds at 2,000 feet AGL will usually be double the velocity of the surface winds and are 30-45° clockwise from the surface winds direction. Most of the change of velocity will occur below 300 feet AGL. The actual ratio of velocities will vary with obstructions and temperature lapse rates (higher ratio with lower-than-standard lapse rate). Example: Surface winds reported at 250/20. Expect the 2,000-foot winds to be about 290/40.
- A tailwind in flight indicates that a low pressure area is to your left (to your right in the southern hemisphere). Example: You have a tailwind while heading north. A low pressure area lies to the west.
- Expect mountain waves if a wind greater than 35 knots is blowing within 30° of perpendicular to a ridge or line of mountains (use the winds-aloft forecast for the altitude nearest to that of the mountain tops). Remember, winds aloft are reported as true, not magnetic.

**Altitudes**

- To determine International Standard Atmosphere (ISA): ISA °C = 15-2 (altitude divided by 1,000) or more simply, ISA decreases 2°C per 1,000 feet from its sea level value of +15°C.
- To determine density altitude, add 1,000 feet for each 15°F (8°C) above ISA. ISA is 59° Fahrenheit. Example: 3,000 feet pressure altitude, 63°F, density altitude = 4,000 feet.
- "High to low, look out below." If you fly to an area with lower pressure and/or temperature, your altimeter will read higher than your actual altitude MSL.

• Flying across the "pond" and confused by altimeter settings in millibars? One inch of mercury equals approximately 34 millibars, or 10 millibars equals 0.3 inches. Example: If the altimeter setting changes by 10 millibars while you're flying, your altitude will be 300 feet off.

• Half of the atmospheric pressure (1013.2 millibars) is below the positive control area (18,000 feet). Example: 500mb charts are for approximately 18,000 feet. Others are proportional (e.g., 850mb are approximately 5,000 feet, 300mb are approximately 30,000 feet).

**Speeds**

• TAS = IAS X (1 + (.02 x altitude divided by 1,000). More simply, TAS increases 2 percent for each 1,000 feet of altitude.

• The diameter of a standard rate turn (SRT—3° per second) in nautical miles = TAS divided by 100 (nice to know for circling approaches). Example: Diameter of a SRT at 200 KTAS is about two miles.

• Angle of bank for a SRT = 15 percent of TAS, or 1/10 of TAS, plus one-half of that number. Example: 100 KTAS requires 15° of bank, 180 KTAS requires 27° bank.

• Speed for tire hydroplaning = nine X square root of the tire pressure. Example: Tire pressure is 100 psi: tires will begin to hydroplane about 90 knots ground speed. This is for your normal, everyday, garden variety of hydroplaning (dynamic) and does not apply to exotic ones, such as reverted rubber and viscous hydroplaning, which can occur at speeds as slow as five knots.

• To compute time between two points, round the ground speed to the nearest multiple of 30 and divide by 60. The result is the number of miles per minute you are traveling. The reason for rounding to a multiple of 30 is to give numbers that are easier to digest. Example: 320 knots rounds up to 330 knots. Dividing by 60 gives a speed of 5½ miles per minute. If your next reporting point is 110 miles away, you should be there in about 20 minutes.

• Is your attention span too short to use the familiar "10 times the distance covered in 6 minutes" to figure DME ground speed? If patience is not one of your virtues, try multiplying 100 times the distance covered in 36 seconds.

**Weather**

• To estimate the bases of convective-type (cumuliform) clouds during warmer parts of the day: the cloud bases will be 222 feet (actually 227 but "three deuces" is easier to remember) above the ground for each 1° of dew point spread. This is based on unsaturated air lapse rate of 5.4°F per 1,000 feet and a dew point decrease of 1°F per 1,000 feet. Example: Temperature 70°, dew point 40°, expect bases at 6,600 feet AGL.

• To quickly estimate the relative humidity, multiply the temperature-dew point spread by 2.5 and subtract the result from 100. The basis for this rule is that a 20°F drop in the dew point represents a 50 percent decrease in the moisture content of the air (specific humidity). Example: Temperature 70°, dew point 60°, RH = 75 percent.

• If the OAT decreases faster than 3°C per 1,000 feet, watch for thunderstorms. A lapse rate greater than the ISA rate indicates unstable air.

• Thunderstorms are usually meanest on the side toward which they are moving (as indicated by the 18,000 foot winds) and on the side from which they are feeding, as indicated by the low-level wind flow (usually southerly). Turbulence inside a storm is usually worst near the freezing level. Do not attempt to verify this statement. Also, the possibility of lightning strikes is probably greatest between ±8°C.

• To convert the temperature from Fahrenheit to Celsius with your pocket calculator or fancy calculator watch, here's the formula: °F = (°C x 1.8) + 32. To convert °C to °F, use: °C - (°F-32) divided by 1.8. If you don't have a calculator handy or you forget the formula, there's hope. By remembering that the ratio of change of temperature in Fahrenheit to Celsius is 9 to 5, it is easy to calculate the Fahrenheit equivalent for each increment of 5°C. Thus, 10°C equals 50°F and 20°C equals 68°F. If these calculations represent the limits of your math ability, an easy way to remember the equivalent of 30°C is to transpose the equivalent of 20 degrees (20°C=68°F, 30°C=86°F). Since a change of 1°C is approximately 2°F (actually 1.8°F), pick the nearest easy-to-remember Fahrenheit equivalent and add or subtract in increments of 2°F to derive other numbers. Thus, 82°F is approximately 28°C.

• If a station is reporting greater than a trace of precipitation, the cloud layer is usually at least 4,000 feet thick.
• In layer-type (stratiform) clouds, icing is rarely found more than 5,000 feet above the freezing level. The area of icing is usually 2,000 to 3,000 feet thick.
• In cumuliform-type clouds, the worst icing is near the tops.

**Descent and Position Information**

• Slant range error for DME is negligible if the distance you are reading is at least 1 mile for each 1,000 feet above the station. Example: You're tuned to the Denver VORTAC (elevation 5,225 feet) and flying at FL 230. If you're showing at least 18 DME, the slant range error is negligible.
• To determine your distance from a selected VOR or TACAN radial, each degree of displacement represents 100 feet per nautical mile from the station, or 1 mile for each 60 miles from the station. Example: The radial for your assigned airway is 270 degrees. You have deviated (with ATC permission) to avoid a thunderstorm and now find yourself on the 275° radial at 60 DME. You are 5 miles, or 30,000 feet, from the centerline of the airway.

**Extras**

• To figure the distance to a VOR/TACAN/NDB which is passing abeam: time to station (in minutes) = the number of seconds for bearing change divided by the number of degrees of bearing change. Example: Your TACAN is inoperative and you're on a vector of 090°. As you pass the Podunk VOR, you notice it takes 100 seconds to travel from the 355° radial to the 005° radial. You quickly calculate you are 10 minutes flying time from Podunk. At your estimated ground speed of 300 knots, you're 50 miles north of the Podunk VOR.
• Your rate of descent on a standard 3° glideslope will be 5 times your ground speed (or half your ground speed times 10).
• A standard 3° glideslope descends about 300 feet per nautical mile or a 1 to 20 ratio. Example: You are on a visual approach to a runway with a touchdown zone 1,000 feet above sea level. You notice from the airport diagram on your approach plate that the TACAN station is located near the departure end of the runway. That means the distance to the touchdown zone will be about one mile less than what your DME shows. If you're at 11 DME and 5,000 feet MSL, you're about 1,000 feet above a 3° glideslope. You should always know your position in relation to that glideslope in order to have a safe, well-managed descent.
• Using the above 1 to 20 ratio for a 3° glideslope, it should be obvious that each foot you are above the ideal glideslope will extend your touchdown 20 feet farther down the runway. This, of course, doesn't apply if you dive for the runway after breaking out at minimums. (This isn't recommended unless you like seeing your name in the newspaper and you enjoy sitting at the end of long green tables.)
• For a localizer or ILS approach, each dot off center on the CDI represents about 200 feet from centerline at the middle marker. (This is based on localizer width of five degrees. The actual range is 3-6 degrees.) Each dot off center on the glideslope represents about 17 feet at the middle marker.

**Putting it Together**

Here's a chance to apply some of the rules to work in a typical situation.

• You're on a PAR approach to Runway 14 at Hill AFB, Utah, elevation 4,788 feet. You're doing a pretty fair job of holding 140 KIAS as your computed approach speed. Approach control tells you the surface winds are 130° at 10 knots. As you pass 6,000 feet, you notice that if you maintain a descent of 500 fpm, the controller keeps reporting "on glideslope." The heading it takes to stay on course is about 5° left of runway centerline. Your quick calculations tell you your ground speed is only 100 knots—pretty slow for the ship you're flying. You use another formula to compute TAS so you'll know the wind component up there. At 6,000 feet, your TAS should be 12 percent higher than IAS. Your quick calculation of 157 knots tells you you have a 50 to 60 knot headwind component with a fairly strong left crosswind. That's quite a bit different from the rule of "45 degrees clockwise and double the velocity" for the 2,000 ft AGL winds. Now, what were those rules for windshear again?

Adapted from *APPROACH Magazine*

# Quick Stoppers

## "Deer" John

Just when you thought the Bird Aircraft Strike Hazard (BASH) program was reducing the chances of aircraft colliding with nature's non-human fauna, something else jumps in your way. The crew of a MAC aircraft operating into an East Coast NAS discovered this the hard way. The crew was unpleasantly surprised during landing roll-out when they struck a deer that was grazing on runway centerline. The results of this encounter included a lot of mushed-up venison and considerable damage to the aircraft's nosegear. The investigator noted this incident was the fourth of its kind to occur over the last several months.

Efforts to reduce this hazard included increased deer hunting in the area, fencing off portions of the runway, cutting back the forest that borders the runway, and chasing deer off the runway with fire trucks. If these efforts prove unsuccessful, the installation commander will take harsher steps to eliminate this problem. In the meantime, beware, particularly at night when deer on the runway may not be seen by tower operators.

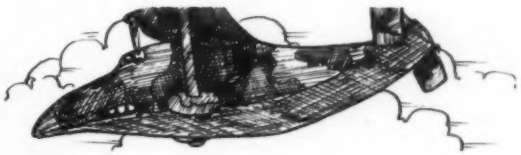
## WHICH SWITCH???

"Haste makes waste" is a cliche one helicopter crew shouldn't soon forget. After an afternoon of performing transition maneuvers, the instructor pilot of a UH-1N training mission decided the copilot needed training in *manual-fuel* emergency procedures. The IP realized the time remaining on the sortie was limited so he directed the copilot to shorten the traffic pattern legs. The copilot complied and called for the Manual Fuel Control System Actuation checklist. The student flight engineer read the first checklist challenge and the copilot responded appropriately by reducing the *number-one* engine throttle to flight idle. The instructor assisted by performing the second checklist item—unfortunately, he placed the *number-two* engine fuel control governor switch to the manual position. This placed the number-two engine in the manual fuel mode while the throttle was full open. Immediately the crew heard a muffled explosion followed by power loss in the number-two engine. The quick-thinking copilot entered autorotation. The IP then analyzed the situation, advanced the number-one throttle to full open, and landed the aircraft using single engine procedures.

Postflight inspection revealed one of the number-two engine's turbine blades exited the engine casing and struck the main drive shaft. Engine replacement cost Uncle Sam over $13,000. The safety investigator reported the shortened traffic pattern combined with the flight engineer reading the checklist slower than normal distracted the IP and prompted him to select the wrong switch.

## Charged-Up Herc

The soon-to-be electrified C-130 crew received a weather briefing which forecast occasional moderate turbulence, light icing, and light precipitation. After takeoff, they were in and out of clouds and spotted some light rainshowers in the area. Although the aircraft's radar didn't show any, ground-based radar displayed significant returns up to 22,000 feet. The aircraft encountered a heavy rainshower with moderate turbulence and light icing. The outside air temperature was -1° C. A bolt of lightning accompanied by a loud bang and a bright flash struck the airplane. The crew smelled something burning coincident to the radar failure. The loadmaster reported lightning passed through the cargo compartment and touched down in at least two places. The crew heard a loud banging noise that was attributed to a broken HF antenna; a 2-inch hole was burned through the beaver tail. Now, what was that about flying in visible moisture with an OAT range of ±8°?



## All In A Day's Work

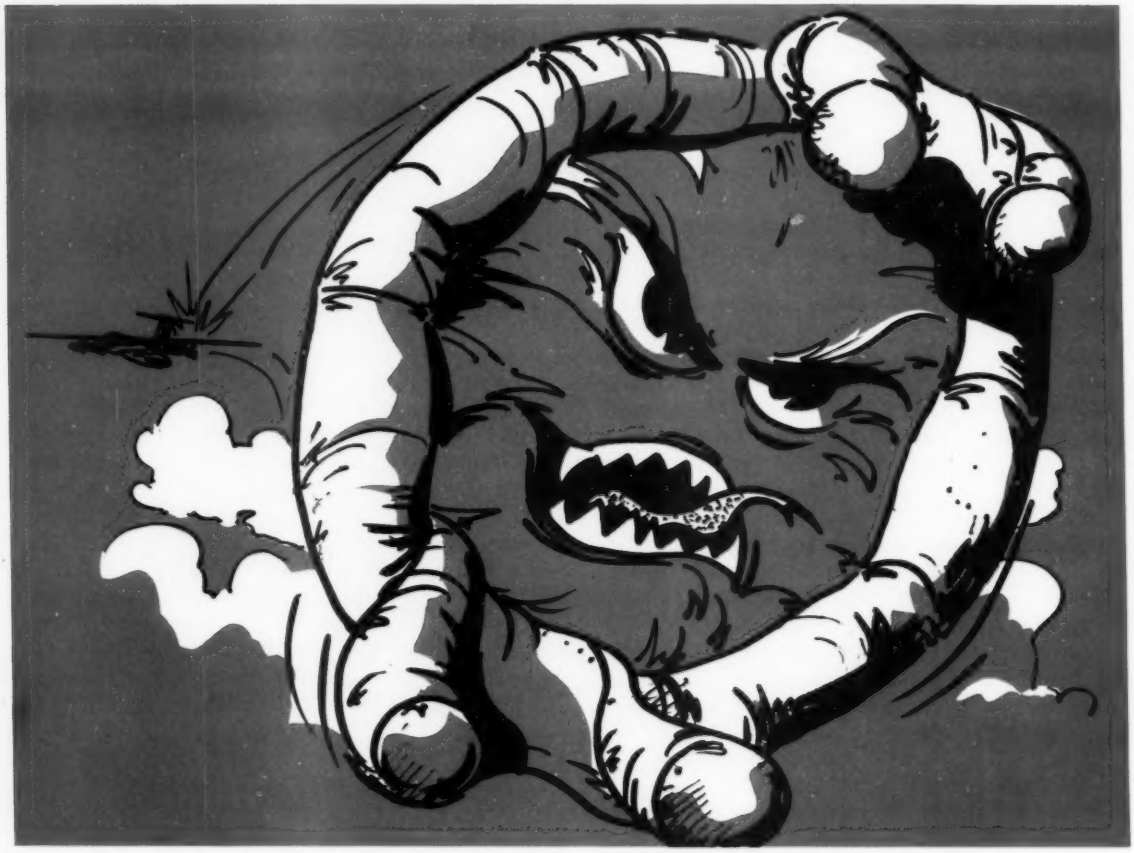
After approximately one hour of flight at FL 090, the C-23A encountered IMC. The crew had the autopilot engaged with the yaw damper off and all the anti-icing equipment on. Ten seconds after the deice boots activated, the aircraft yawed right, pitched up, and entered an uncommanded hard right bank. The aircraft began a spiraling descent in IMC. The aircraft commander disconnected the autopilot, neutralized the controls and applied power. The aircraft entered VMC at 1,000-feet AGL and recovered at 700-feet AGL. The crew performed a controllability check, determined the aircraft airworthy, diverted, and landed uneventfully. This mishap is still under investigation.

## ACHING ABCESS

The aircraft commander of a C-141 discovered the insidious effects of an abscessed tooth. After leveling off at cruising altitude enroute to his European stopover point, the AC began experiencing chills, nausea, and symptoms of fever. In fact, it got so bad that he didn't think he should fly the approach and landing. The ailing AC wisely surrendered the controls to the copilot who adeptly diverted the mission to the nearest suitable airfield and smoothly landed the Starlifter.

After the flight, the AC was immediately taken to a local hospital. A quick check of his vital signs revealed a 101.6° temperature. The problem was diagnosed as a tooth abscess and the medical staff quickly referred the AC to a dentist who remedied the problem.

# Quick Stoppers



## LIFE THREATENING LIFERAFT

It had been a rather hectic day for two C-141 crews. The mission was a scheduled over-water formation flight enroute to their Pacific destination. Before takeoff, the crew of the second aircraft discovered their station keeping equipment was inoperative so the flight departed using vertical IFR traffic separation procedures. The flight transitioned to VFR when ARTCC could no longer authorize block altitudes for the formation due to extensive air traffic along their route. The number-two aircraft was less than one-half mile in trail and slightly below lead, when suddenly lead's right wing life raft and accessory kit departed the airplane. The life raft drifted back and hit the left wing of the number-two aircraft. Both aircraft continued to destination and landed uneventfully.

Maintenance personnel discovered that the number-two aircraft sustained damage to the number-two engine pylon and the left wing leading edge. On the lead aircraft, all five latches on the right wing life raft access door sheared off and small cracks were found in the life raft case.

Investigators surmised the raft inflated before it departed the Starlifter. One likely cause of this untimely inflation is an improperly set manual vent valve.

# After Deadlines

**THE 304TH ARRS CREDITED WITH SAVING 14 LIVES**—When a planned one-day boy scout hike was interrupted by freezing drizzle and an 18-inch accumulation of snow, the young men had no choice but to stay put. They had planned to hike from Larch Mountain to Multnomah Falls and took no overnight gear, since they would be at the Multnomah Falls Lodge by nightfall. When they failed to arrive, the Lodge notified the local sherrif's office, and they, in turn, organized a ground rescue party to search the area. They also requested the 304th ARRS conduct an air search. Shortly after the takeoff, the crew was informed one of the scoutmasters had walked out of the search area and pinpointed the boy's location 1¼ miles above the falls. The ground search was discontinued after darkness because of the icy conditions, and the 304th was asked to resume the air search. Twenty minutes after liftoff, the crew spotted a fire on a steep hillside. The crew lowered a pararescueman who established ground communication and requested an airdrop of blankets and clothing. Since there were no injuries and the level of hypothermia was low and controllable with the airdropped items, the recovery was postponed to daybreak. The next morning, two helicopters and crews from the 304th ARRS extracted all 14 hikers.

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**FAA PUBLISHES FINAL POSITION**—The FAA has issued a final rule requiring pilots of aircraft equipped with transponders to keep the devices turned on when flying in controlled airspace. Currently, all air carrier aircraft and approximately 70 percent of the general aviation fleet have this equipment. This new rule does not expand the requirement for transponders which presently must be installed and activated for flights in designated control areas and in en route airspace above 12,500 feet. But pilots who have this equipment now will be required to have it turned on when operating in all other controlled airspace, such as airport control areas, designated federal airways, and transition zones. The only exceptions to this requirement will be those authorized by controllers for operational reasons such as excessive radar clutter caused by too many transponder replies in busy traffic areas. In these situations, controllers can continue to instruct pilots to turn their transponders to "stand by," or completely off. (Courtesy The ATCA Bulletin, ISSN 0400-1915)

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**129TH ARRG RECORDS 33 "SAVES" IN FOUR DAYS**—Crewmembers from the California Air National Guard's 129th ARRG, using four HH-3E helicopters and two HC-130 Hercules effected the rescues from the severely flooded areas in Northern California. Altogether, 129th helicopters and C-130s, working closely with Army personnel, airlifted approximately 2,000 people to safety during the four days.

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# Touch 'n Go

EENIE-MEENIE-MYNIE
MOE, which of these
will Make us GO!
C'mon
C'mon
Get the
Shields up!